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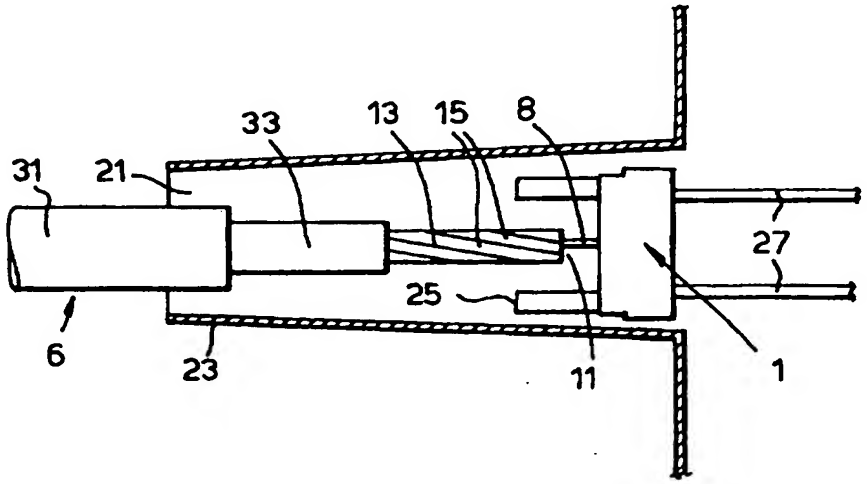

(57) Abstract

A device for organizing a plurality of optical fibres extending from an end of an optical fibre cable, comprising a support arranged to be attached to an end of an optical fibre cable, the support containing one or more slots, the or each of which may accommodate a plurality of optical fibres extending from the end of the cable, the or each slot including at least two open-sided channels, the open side of each of which opens into the slot, each channel being capable of accommodating one or more of the optical fibres which may be accommodated in that slot.

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Device for Organizing Optical Fibres

The present invention relates to a device for organizing a plurality of optical fibres extending from an end of an optical fibre cable. The invention also relates to an optical fibre organizer including such a device, an optical fibre cable splice closure including such an organizer, and a method of organizing optical fibres by means of the device.

European patent application No. 0092441 (Raychem) discloses an assembly for terminating a fibre optic cable, that has the optical fibres located in external channels of a cable core member. The assembly comprises a plurality of polymeric sleeves for fitting over the individual exposed optical fibres to protect them up to the cut-back end of the cable. The sleeve fibres are provided as a snap-fit into longitudinal channels in the outer surface of a cylindrical support member that is mounted on the end of the cable. A heat-recoverable polymeric sleeve is recovered over the end of the cable and the support member, and is provided with meltable inserts whereby the cable end is environmentally sealed.

International patent application no. WO91/12548 (Raychem) discloses a method of terminating an optical fibre cable, in which the cable jacket is stripped back a certain length, the exposed cable core is cut away by a shorter length, an organizer is positioned a short distance from the newly formed end of the core, and a housing is positioned to bridge the core and the organizer. The organizer is preferably substantially cylindrical, and contains either holes or slots into which the fibres of the cable may be inserted.

The assembly of EP 0092441, and the method and organizer of WO91/12548, perform well for their intended purposes. However, the inventors of the present invention invented a new device which provides a greater degree of organization, and a greater degree or organizational versatility, than known organizers and assemblies. The new device can also provide other advantages which will be explained below.

According to a first aspect, the present invention provides a device for organizing a plurality of optical fibres extending from an end of an optical fibre cable, comprising a support arranged to be attached to an end of an optical fibre cable, the support containing one or more slots, the or each of which may accommodate a plurality of optical fibres extending from the end of the cable, the or each slot including at least two open-sided channels, the open side of each of which opens into the slot, each channel being capable of accommodating one or more of the optical fibres which may be accommodated in that slot.

The device according to the invention has the following advantages. Because the or each slot includes at least two channels, optical fibres accommodated in the or each slot may be separated into individual fibres, or bundles or groups of fibres. This is particularly useful, for example, when the optical fibres are arranged in the cable in a plurality of bundles or groups of fibres (which bundles or groups of fibres are often termed " cable elements"). In this case, each element (i.e. bundle or group of fibres) from the cable may be individually accommodated in a respective slot in the support, and the optical fibres of each element may be further organized (i.e. separated) in the channels of that slot. The optical fibre cable may, for example, be a so-called "slotted-core" (i.e. having a core with slots in its periphery which contain the fibres), with each element arranged in a respective slot of the cable core. For example, if the optical fibres of the cable are arranged in ribbons (which typically contain four, eight or twelve fibres), each element of the cable (i.e. each group or bundle of ribbons) may be individually accommodated in a respective slot in the support of the device, and each ribbon of each element may be individually accommodated in a respective channel of that slot. Typically, a cable may have, for example, five bundles or groups of ribbons (i.e. five elements), with perhaps five ribbons in each bundle or group. Alternatively, the cable may not have its optical fibres arranged in ribbons, in which case groups or bundles (elements) of individual fibres (rather than ribbons) may be accommodated in the slots of the support, and smaller bundles or groups, or pairs, or even individual fibres, may be accommodated in the channels. Whether or not the fibres are arranged

in ribbons, the support may advantageously be provided with the appropriate number of slots and/or channels per slot, appropriate for the cable with which it is to be used.

The increased degree of fibre organization which the present invention provides, has a number of benefits. For example, the fact that the individual cable elements may be kept separate while allowing individual fibres, or bundles or groups of fibres, from each element to be separated from each other (an organizational system which may be regarded as a "two tier" system), has the advantage of facilitating the identification, handling and routing of the fibres as they extend from the end of a cable. Furthermore, the fact that each slot includes a plurality of channels means that it is normally possible to store or accommodate a bundle or group of fibres (e.g. a single cable element) in a slot, and at a later time, if required, to divide this bundle or group of fibres into smaller bundles or groups of fibres, or individual fibres, and to store or accommodate them in the channels of that slot, without having to disturb or rearrange the other fibres accommodated in the device. Thus, for example, originally unspliced or unconnected fibres may be conveniently organized in a slot of the device until such time as they need to be spliced or connected, and then they may be further organized (for example to aid identification, handling and/or routing) in the channels of the slot, at that later time. The originally unspliced or unconnected fibres may, for example, be looped in an organizer or a closure.

As already stated, the device according to the first aspect of the invention is for organizing optical fibres extending from an end of an optical fibre cable, and the support is arranged to be attached to the end of the cable. By the "end" of a cable is generally meant a region of the cable beyond which the individual optical fibres, or groups or bundles of the fibres, of the cable extend substantially independently of each other. For example, if the cable is a so-called "slotted-core" type of cable, the end of the cable will normally be at or near the end of the core.

The device has particular utility, for example, for organizing optical fibres extending from an end of an optical fibre cable and which are spliced or connected to

other optical fibres, or connected to optical or optoelectronic devices (e.g. splitters). The device may, for example, be attached to an end of an optical fibre cable, the optical fibres of which extend into or onto an optical fibre organiser. The cable may, for example, extend into a closure, e.g. a cable splice closure, a cabinet or a rack. Irrespective of the destination of the optical fibres, however, the end of the cable will generally need to be prepared by cutting away some of the outer jacketing and cable core(s) or other fibre carriers of the cable, prior to attachment of the device.

According to a second aspect, the invention provides an optical fibre organizer, comprising:

(a) means for storing a plurality of optical fibre splices and/or splitters and/or connectors; and

(b) at least one device according to the first aspect of the invention.

According to a third aspect, the invention provides an optical fibre closure, comprising:

(a) an optical fibre organizer according to the second aspect of the invention; and

(b) a casing arranged to enclose the optical fibre organizer.

In the broadest aspect of the invention, the or each slot in the support of the device may have generally any shape, i.e. it may comprise generally any shape of opening or aperture in the support. Preferably, however, the or each slot has a generally elongate transverse cross-section (by "transverse" is meant transverse with respect to the axis of an optical fibre extending through the slot). Preferably, the or each slot is open to, and extends from, a periphery of the support. This has the advantage that the optical fibres extending from the end of the cable may be inserted into the slot(s) without having to thread an end of the fibres through the slot(s) (i.e. the insertion may be by so-called side-entry). The or each slot preferably extends from the periphery of the support in a direction which is substantially transverse, more preferably substantially perpendicular, with respect to the axis of the cable to which

the support is attached, in use. The periphery of the support is thus preferably a transverse periphery with respect to the axis of the cable. More preferably, the or each slot extends from the periphery of the support in a direction which is substantially radial with respect to the axis of the cable. Advantageously, the periphery of the support may be generally round, preferably generally circular, in transverse cross-section. The support may, for example, be generally in the shape of a disc.

In preferred embodiments, the support contains at least two slots. Ordinarily, the support will contain no more than, say, twelve slots. Typical numbers of slots are three, four five, six, seven or eight. Each slot includes at least two open-sided channels, the open side of each or which opens into the slot. Similarly to the typical numbers of slots per support, typical numbers of channels per slot are three, four, five, six, seven or eight. Ordinarily, there will be no more than thirteen channels in each slot. Different slots may include different numbers of channels but normally each slot will include the same number of channels as each other slot.

The arrangements of the channels in the slot(s) is preferably such that at least one of the channels is situated in a side of the slot. More preferably, the or each slot includes at least two channels arranged spaced-apart in at least one side of the slot. In some preferred embodiments at least one channel in the or each slot is larger in (transverse) cross-section than at least one other, smaller, channel in the same slot. ("Transverse" in this instance again means transverse with respect to the axis of an optical fibre extending in use, through the channel; it is normally equivalent to transverse with respect to the axis of the cable). The or each larger channel may, for example, accommodate optical fibres which are not spliced, connected, or attached to optical or optoelectronic devices. Such optical fibres may, for example, be looped, i.e. routed into and out of an organizer or closure without being terminated in some way. Such looped, fibres may subsequently be spliced, connected etc., in which case they may be organized in spare channels in the same slot (or they may be accommodated in spare channels in other slots in the support, although this option is generally less preferred). Advantageously the or each slot may include a single larger channel and a

plurality of smaller channels. The larger channel may, for example, be situated in a closed end of the slot, preferably opposite an open end of the slot.

In particularly preferred embodiments of the invention, each channel is arranged to accommodate at least one optical fibre carrier, in or on which the or each optical fibre (e.g. the or each ribbon of optical fibres) accommodated in that channel may be carried, in use, from the device away from the end of the cable (e.g. into an organizer). Such a carrier may, for example, protect the optical fibre or fibres which it carries. Preferred types of carriers are hollow, e.g. tubes, which contain the optical fibre(s). Such tubes may, for example, have a helical slit which enables them to be wrapped around one or more fibres and, if required, unwrapped to expose the fibre(s). Preferably each channel is arranged to accommodate a single carrier, e.g. a single tube. The carriers may, for example, be accommodated in the channels as an interference-fit or a snap-fit.

The device is preferably attachable to the cable such that, under normal conditions of use, the device is substantially unable to move (e.g. axially, or by twisting) with respect to the cable end. This has the advantage that the placing of the optical fibres under stress by relative movement between the device and the end of the cable will normally be substantially avoided (and thus optical losses and/or damage to the fibres may be prevented). The support of the device may generally be attached to the cable in any suitable way. It may even, in some embodiments, be secured with respect to the cable indirectly, i.e. via another member. For example, the cable and the support may each be attached to a casing (e.g. a casing of a closure) or other member, but not directly attached to each other (other than by virtue of the fact that the optical fibres of the cable extend through slots in the support). It is more preferred, however, for the cable and the support to be attached directly to each other. One preferred method of attachment is via a strength member, e.g. an axially central strength member, of the cable. (Such a strength member may, for example, be formed from glass-fibre or Kevlar (trade mark) fibre reinforced polymer, or metal wire or cable.) Preferably therefore, the device includes attachment means for attaching the

support to a strength member of the optical fibre cable. The attachment means may advantageously comprise a screw-threaded member, and a screw-threaded passage in the support which communicates with a hole arranged in the support to receive a strength member of the cable, whereby the screw-threaded member may be screwed into the passage and into gripping engagement with the strength member.

As mentioned above, devices according to the invention may, for example, be used in closures which have a casing to enclose an organizer or the like. Advantageously, the or each device in the closure may be located, in use, in a cable-entry port in the casing. The device will be attached to the cable, but it is preferably not directly attached to the casing. Thus if the cable moves (e.g. by twisting or axially) the device preferably moves with the cable substantially unhindered. During the service life of the closure, the cables entering the closure may be subjected to forces which cause them, or their cores, to move further into the closure (this is sometimes called "cable grow-out"). In order to ensure that the devices attached to the cable ends remain located in their respective cable-entry ports even in the event of some cable grow-out, the support may advantageously have one or more extensions extending therefrom towards the cable. Such extensions may therefore remain located in the port even if the main part of the device is forced out of the port and further into the closure.

The optical fibre cable will often include an earthing conductor. The support of the device may include a recess in a periphery of the support, which is arranged to accommodate such an earthing conductor.

A fourth aspect of the invention provides a method of organizing a plurality of optical fibres extending from an end of an optical fibre cable, comprising:

(a) placing at the end of the cable, a support of a device according to the first aspect of the invention;

(b) inserting said optical fibres in the slots in the support; and

(c) attaching the support to the end of the cable.

Step (b) may be performed before steps (a) and/or (c), but preferably the method is carried out by performing step (a), then step (b), then step (c).

Step (b) of the method may advantageously further comprise:

(i) separating into a plurality of groups of fibres, or a plurality of individual fibres, some or all of the optical fibres which have been inserted, or which are to be inserted, into one said slot; and

(ii) individually inserting each of these individual fibres or groups of fibres into a respective channel of that slot.

The method may further comprise:

(d) inserting into or onto a respective optical fibre carrier each individual fibre or group of fibres, and inserting each of the optical fibre carriers into the channel in which the individual fibre or group of fibres which it carries have been, or are to be, inserted.

Step (d) may be performed before or after step (a) and/or step (c), and it may comprise part of step (b) or it may be a separate method step.

The invention will now be described, by way of example, with reference to the accompanying drawings, of which:

Figure 1 shows two views of a device according to the invention; and

Figure 2 shows, schematically, a device according to the invention attached to an end of an optical fibre cable and located in a cable-entry port of a closure.

Figure 1A shows an end view, and Figure 1B shows a longitudinal cross-sectional view, of a preferred device according to the invention. The device

comprises a support 1, generally in the shape of a disc, containing five slots 3, each slot including five relatively small open-sided channels 5a in the walls of the slot, and one relatively large channel 5b at a closed end of the slot. The support 1 is arranged to be attached to an end of an optical fibre cable 6 (see Figure 2) by being secured to the axially central strength member 8 of the cable by means of a screw-threaded passage 7 in the support 1 which communicates with a hole 9 arranged in the support 1 to receive the strength member 8, whereby a screw-threaded member (not shown) may be screwed into the passage 7 and into gripping engagement with the strength member 8 in order to effect such securement.

Each slot 3 in the support 1 is open to, and extends from, a generally circular transverse periphery 17 of the support, and extends from the periphery in a direction which is substantially radial with respect to the axis of the cable 6. The radially-inward end of each slot 3 is closed and comprises an open-sided relatively large channel 5b. Situated in the sides 19 of each slot 3 are open-sided relatively small channels 5a, the open sides of which open into the slot. Because the slots 3 are open to the periphery 17 of the support 1, and the channels 5a, 5b are open to their respective slots 3, the optical fibres extending from the end of the optical fibre cable 6 may be inserted in a side-entry manner into the slots and channels.

In use, the device organizes a plurality of optical fibres extending from an end 11 of an optical fibre cable 6 (for clarity, these optical fibres are not shown in Figure 2). A core 13 of the cable 6 contains five helical slots 15, each of which contains a group or bundle of optical fibres (which may be called a single cable element). Each group or bundle of fibres is accommodated in a respective slot 3 in the support 1 of the device. If a particular group or bundle of fibres (which may, for example, be a plurality of fibre ribbons) is not spliced, connected or attached to an optical or optoelectronic device, it may be accommodated in the relatively large channel 5b at the closed end of the slot. If fibres of the group or bundle are spliced or connected etc., they may be further organized by being separated into one to five smaller bundles or groups (e.g. one to five ribbons) or individual fibres, and each group or bundle, or

individual fibre may be accommodated in a respective relatively small channel 5a. Such further organized fibres may then be easily identified, handled and routed as required.

Figure 2 shows, schematically, the device attached to an end of the optical fibre cable 6 and located in a cable-entry port 21 in a casing 23 of a closure. The closure may, for example, enclose an optical fibre organizer in which the optical fibres of the cable 6 are organized, spliced or connected, and stored. The support 1 has extensions 25 extending therefrom towards the cable 6, which are designed to ensure that the device remains located in the port 21 even in the event of some cable grow-out into the closure (i.e. movement of the cable towards the right hand side as drawn in Figure 2), as mentioned earlier.

The optical fibres extending from the device away from the end of the cable 6 (e.g. into the interior of the closure) may be protected by optical fibre carriers 27, which are preferably tubes which contain the optical fibres. These carrier tubes 27 are preferably individually accommodated in the channels 5a, 5b, e.g. as an interference fit. Each of the channels 5a, 5b preferably contains an internal shoulder 29 against which a carrier tube 27 inserted into the channel may be seated.

Prior to the insertion of the optical fibres into the device, the end of the cable 6 is preferably prepared by stripping back some of the outer cable jacketing 31, the inner cable jacketing 33, and the cable core 13, to expose some of the central strength member 8, the core 13 and the inner jacketing 33. The cable 6 may include an earthing or grounding conductor (not shown) which may be accommodated in the recess 35 in the periphery of the support 1.

Claims

1. A device for organizing a plurality of optical fibres extending from an end of an optical fibre cable, comprising a support arranged to be attached to an end of an optical fibre cable, the support containing one or more slots, the or each of which may accommodate a plurality of optical fibres extending from the end of the cable, the or each slot including at least two open-sided channels, the open side of each of which opens into the slot, each channel being capable of accommodating one or more of the optical fibres which may be accommodated in that slot.

2. A device according to Claim 1, in which the or each slot is open to, and extends from, a periphery of the support.

3. A device according to Claim 2, in which the or each slot extends from said periphery of the support in a direction which is substantially transverse, preferably substantially perpendicular, with respect to the axis of the cable.

4. A device according to Claim 2 or Claim 3, in which the or each slot extends from said periphery of the support in a direction which is substantially radial with respect to the axis of the cable.

5. A device according to any one of Claims 2 to 4, in which said periphery is generally circular in transverse cross-section.

6. A device according to any preceding Claim, in which the support contains at least two, and no more than twelve, said slots.

7. A device according to any preceding Claim, in which the or each slot includes no more than thirteen said channels.

8. A device according to any preceding Claim, in which at least one said channel is situated in a side of a said slot.

9. A device according to any preceding Claim, in which the or each slot includes at least two said channels arranged spaced-apart in at least one side of the slot.

10. A device according to any preceding Claim, in which at least one said channel in a said slot is larger in cross-section than at least one other, smaller, said channel in the same slot.

11. A device according to Claim 10, in which the or each slot includes a single said larger channel and a plurality of said smaller channels.

12. A device according to any preceding Claim, in which each channel is arranged to accommodate at least one optical fibre carrier, in or on which the or each optical fibre accommodated in that channel may be carried, in use, from the device away from the end of the cable.

13. A device according to Claim 12, in which said optical fibre carrier comprises a tube in which said optical fibre or fibres may be so carried, and each channel is arranged to accommodate a single said tube.

14. A device according to Claim 12 or Claim 13, in which each channel is arranged to accommodate said carrier(s) as an interference-fit or a snap-fit.

15. A device according to any preceding Claim, in which the support has one or more extensions extending therefrom towards the cable.

16. A device according to any preceding Claim, which includes attachment means for attaching the support to a strength member of the cable.

17. A device according to Claim 16, in which said attachment means comprise a screw-threaded member, and a screw-threaded passage in the support which communicates with a hole arranged in the support to receive a said strength member, whereby the scew-threaded member may be screwed into the passage and into gripping engagement with the strength member.

18. A device according to any preceding Claim, in which the support includes a recess in a periphery of the support, which is arranged to accommodate an earthing conductor of the cable.

19. An optical fibre organizer, comprising:

(a) means for storing a plurality of optical fibre splices and/or splitters and/or connectors; and

(b) at least one device according to any preceding Claim.

20. An optical fibre closure, comprising:

(a) an optical fibre organizer according to Claim 19; and

(b) a casing arranged to enclose the optical fibre organizer.

21. A method of organizing a plurality of optical fibres extending from an end of an optical fibre cable, comprising:

(a) placing, at the end of the cable, a support of a device according to any one of claims 1 to 18;

(b) inserting said optical fibres in said slots in the support; and

(c) attaching the support to the end of the cable.

22. A method according to Claim 21, in which step (b) further comprises:

(i) separating into a plurality of groups of fibres, or plurality of individual fibres, some or all of the optical fibres which have been inserted, or which are to be inserted, into one said slot; and

(ii) individually inserting each of these individual fibres or groups of fibres into a respective channel of that slot.

23. A method according to Claim 22, further comprising:

(d) inserting into or onto a respective optical fibre carrier each said individual fibre or group of fibres, and inserting each of the optical fibre carriers into the channel in which the individual fibre or group of fibres which it carries have been, or are to be, inserted.

Fig.1 A.

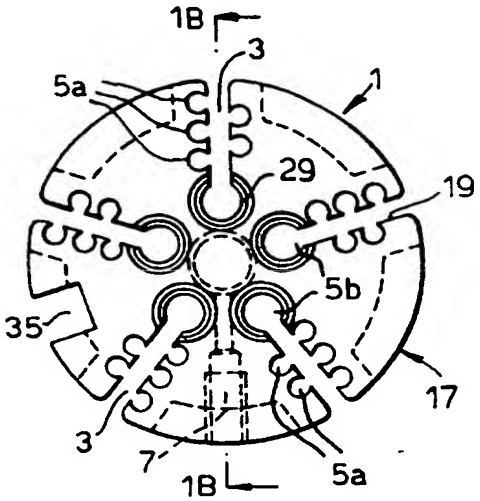


Fig.1B.

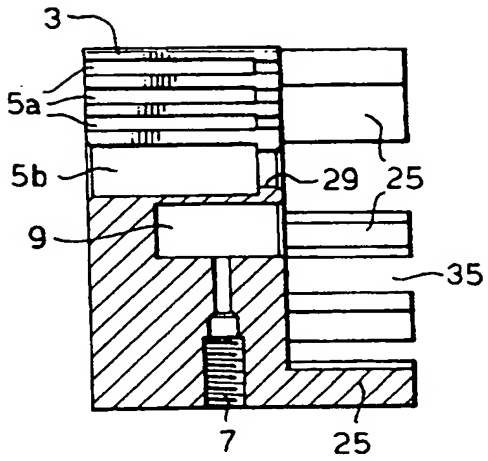
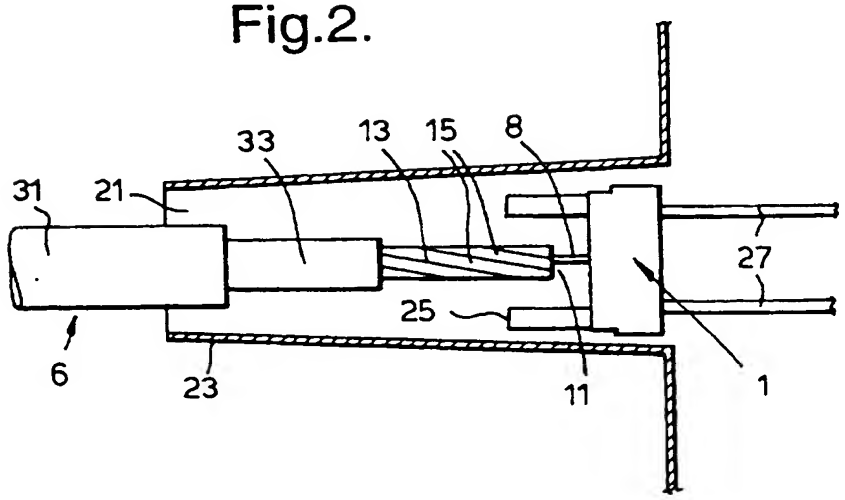


Fig.2.



INTERNATIONAL SEARCH REPORT

Inte. .onal Application No
PCT/GB 97/00950

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G02B6/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 95 25978 A (RAYCHEM SA NV ;RAYCHEM LTD (GB); MENDES LUIZ NEVES (BE)) 28 September 1995	1-4
A	see claims; figures	12,19-21
Y	DE 40 29 082 A (ROSE WALTER GMBH & CO KG) 19 March 1992	1-4
A	see claims; figures	10,16
Y	EP 0 650 239 A (KABELMETAL ELECTRO GMBH) 26 April 1995 see claims; figures	1
Y	US 5 479 554 A (ROBERTS GENE) 26 December 1995 see claims; figures	1
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Int. ..onal Application No
PCT/GB 97/00950

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